CLAIMS

I/WE CLAIM:

1. A wavemeter for a high repetition rate gas discharge laser having a laser output beam comprising a pulsed output of greater than or equal to 15 mJ per pulse, sub-nanometer bandwidth tuning range pulses having a femptometer bandwidth precision and tens of femptometers bandwidth accuracy range, for measuring bandwidth on a pulse to pulse basis at pulse repetition rates of 4000Hz and above, comprising:

a focusing lens having a focal length;

an optical interferometer creating an interference fringe pattern;

an optical detector positioned at the focal length from the focusing lens;

a bandwidth calculator calculating bandwidth from the position of interference fringes in the interference fringe pattern incident on the optical detector, defining a D_{ID} and a D_{OD}, the respective distances between a pair of first fringe borders and between a pair of second fringe borders in the interference fringe pattern on an axis of the interference pattern, and according to the formula $\Delta\lambda = \lambda_0 [D_{OD}^2 - D_{ID}^2] / [8f^2 - D_0^2]$, where λ_0 is an assumed constant wavelength and $D_0 = (D_{OD} - D_{ID})/2$, and f is the focal length.

2. The apparatus of claim 1 further comprising:

the optical detector is a photodiode array.

3. The apparatus of claim 1, further comprising:

the optical interferometer having a slit function;

the slit function and the focal length being selected to deliver to the optical detector the two innermost fringes of the optical interference fringe pattern.

4. The apparatus of claim 2, further comprising:

the optical interferometer having a slit function;

the slit function and the focal length being selected to deliver to the optical detector the two innermost fringes of the optical interference fringe pattern.

5. The apparatus of claim 1, further comprising:

the optical detector comprising an array of pixels each having a height and width and the array having a total width;

an aperture at the optical input to the optical interferometer selectively inputting to the optical interferometer a portion of a beam of light sufficient for the output of the optical interferometer to illuminate the optical detector over the height of each respective pixel.

6. The apparatus of claim 2, further comprising:

the optical detector comprising an array of pixels each having a height and width and the array having a total width;

an aperture at the optical input to the optical interferometer selectively inputting to the optical interferometer a portion of a beam of light sufficient for the output of the optical interferometer to illuminate the optical detector over the height of each respective pixel height.

7. The apparatus of claim 3, further comprising:

the optical detector comprising an array of pixels each having a height and width and the array having a total width;

an aperture at the optical input to the optical interferometer selectively inputting to the optical interferometer a portion of a beam of light sufficient for the output of the optical interferometer to illuminate the optical detector over the height of each respective pixel height.

8. The apparatus of claim 4, further comprising:

the optical detector comprising an array of pixels each having a height and width and the array having a total width;

an aperture at the optical input to the optical interferometer selectively inputting to the optical interferometer a portion of a beam of light sufficient for the output of the optical interferometer to illuminate the optical detector over the height of each respective pixel height.

9. The apparatus of claim 1 further comprising:

the optical interferometer is an etalon.

10. The apparatus of claim 2 further comprising:

the optical interferometer is an etalon.

11. The apparatus of claim 3 further comprising:

the optical interferometer is an etalon.

12. The apparatus of claim 4 further comprising:

the optical interferometer is an etalon.

13. The apparatus of claim 5 further comprising:

the optical interferometer is an etalon.

14. The apparatus of claim 6 further comprising:

the optical interferometer is an etalon.

15. The apparatus of claim 7 further comprising:

the optical interferometer is an etalon.

16. The apparatus of claim 8 further comprising:

the optical interferometer is an etalon.

17. The apparatus of claim 9 further comprising:

the etalon is an etalon having a slit function of 3pm or less and a finesses of 25 or greater; and

the focal length is 1.5 meters.

18. The apparatus of claim 10 further comprising:

the etalon is an etalon having a slit function of 3pm or less and a finesses of 25 or greater; and

the focal length is 1.5 meters.

19. The apparatus of claim 11 further comprising:

the etalon is an etalon having a slit function of 3pm or less and a finesses of 25 or greater; and

the focal length is 1.5 meters.

20. The apparatus of claim 12 further comprising:

the etalon is an etalon having a slit function of 3pm or less and a finesses of 25 or greater; and

the focal length is 1.5 meters.

21. The apparatus of claim 13 further comprising:

the etalon is an etalon having a slit function of 3pm or less and a finesses of 25 or greater; and

the focal length is 1.5 meters.

22. The apparatus of claim 14 further comprising:

the etalon is an etalon having a slit function of 3pm or less and a finesses of 25 or greater; and

the focal length is 1.5 meters.

23. The apparatus of claim 15 further comprising:

the etalon is an etalon having a slit function of 3pm or less and a finesses of 25 or greater; and

the focal length is 1.5 meters.

24. The apparatus of claim 16 further comprising:

the etalon is an etalon having a slit function of 3pm or less and a finesses of 25 or greater; and

the focal length is 1.5 meters.

25. The apparatus of claim 17 further comprising:

a first diffuser delivering a narrow cone of light to the etalon.

26. The apparatus of claim 18 further comprising:

a first diffuser delivering a narrow cone of light to the etalon.

27. The apparatus of claim 19 further comprising:

a first diffuser delivering a narrow cone of light to the etalon.

28. The apparatus of claim 20 further comprising:

a first diffuser delivering a narrow cone of light to the etalon.

29. The apparatus of claim 21 further comprising:

a first diffuser delivering a narrow cone of light to the etalon.

30. The apparatus of claim 22 further comprising:

a first diffuser delivering a narrow cone of light to the etalon.

31. The apparatus of claim 23 further comprising:

a first diffuser delivering a narrow cone of light to the etalon.

32. The apparatus of claim 24 further comprising:

a first diffuser delivering a narrow cone of light to the etalon.

33. The apparatus of claim 25 further comprising:

an aperture between the first diffuser and the etalon delivering to the etalon a thin strip of the narrow cone of light.

34. The apparatus of claim 26 further comprising:

an aperture between the first diffuser and the etalon delivering to the etalon a thin strip of the narrow cone of light.

35. The apparatus of claim 27 further comprising:

an aperture between the first diffuser and the etalon delivering to the etalon a thin strip of the narrow cone of light.

36. The apparatus of claim 28 further comprising:

an aperture between the first diffuser and the etalon delivering to the etalon a thin strip of the narrow cone of light.

37. The apparatus of claim 29 further comprising:

an aperture between the first diffuser and the etalon delivering to the etalon a thin strip of the narrow cone of light.

38. The apparatus of claim 30 further comprising:

an aperture between the first diffuser and the etalon delivering to the etalon a thin strip of the narrow cone of light.

39. The apparatus of claim 31 further comprising:

an aperture between the first diffuser and the etalon delivering to the etalon a thin strip of the narrow cone of light.

40. The apparatus of claim 32 further comprising:

an aperture between the first stage diffuser and the etalon delivering to the etalon a thin strip of the narrow cone of light.

41. A wavemeter for a high repetition rate gas discharge laser having a laser output beam comprising a pulsed output of greater than or equal to 15 mJ per pulse, sub-nanometer bandwidth tuning range pulses having a femptometer bandwidth precision and tens of femptometers bandwidth accuracy range, for measuring bandwidth on a pulse to pulse basis at pulse repetition rates of 4000Hz and above, comprising:

a focusing lens having a focal length;

an optical interference pattern generating means for creating an interference fringe pattern;

an optical detection means positioned at the focal length from the focusing lens;

a bandwidth calculating means for calculating bandwidth from the position of interference fringes in the interference fringe pattern incident on the optical detection means, defining a D_{ID} and a D_{OD}, the respective distances between a pair of first fringe borders and between a pair of second fringe borders in the interference fringe pattern on an axis of the interference pattern, and according to the formula $\Delta\lambda = \lambda_0 [D_{OD}^2 - D_{ID}^2] / [8f^2 - D_0^2]$, where λ_0 is an assumed constant wavelength and $D_0 = (D_{OD} - D_{ID})/2$, and f is the focal length.

42. The apparatus of claim 41 further comprising:

the optical detection means is a photodiode array.

43. The apparatus of claim 41, further comprising:

the optical interference pattern generating means having a slit function;

the slit function and the focal length being selected to deliver to the optical detection means the two innermost fringes of the optical interference ring pattern.

44. The apparatus of claim 42, further comprising:

the optical interference pattern generating means having a slit function;

the slit function and the focal length being selected to deliver to the optical detector the two innermost fringes of the optical interference ring pattern.

45. The apparatus of claim 41, further comprising:

the optical detection means comprising an array of pixels each having a height and width and the array having a total width;

an aperture at the optical input to the optical interferometer selectively inputting to the optical interference pattern generating means a portion of a beam of light sufficient for the output of the interference pattern generating means to illuminate the optical detection means over the height of each respective pixel height and the total width.

46. The apparatus of claim 42, further comprising:

the optical detection means comprising an array of pixels each having a height and width and the array having a total width;

an aperture at the optical input to the optical interferometer selectively inputting to the optical interference pattern generating means a portion of a beam of light sufficient for the output of the interference pattern generating means to illuminate the optical detection over the height of each respective pixel height and the total width.

47. The apparatus of claim 43, further comprising:

the optical detection means comprising an array of pixels each having a height and width and the array having a total width;

an aperture at the optical input to the optical interferometer selectively inputting to the optical interference pattern generating means a portion of a beam of light sufficient for the output of the interference pattern generating means to illuminate the optical detection means over the height of each respective pixel height and the total width.

48. The apparatus of claim 44, further comprising:

the optical detection means comprising an array of pixels each having a height and width and the array having a total width;

an aperture at the optical input to the optical interferometer selectively inputting to the optical interference pattern generating means a portion of a beam of light sufficient for the output of the interference pattern generating means to illuminate the optical detection means over the height of each respective pixel height and the total width.

49. The apparatus of claim 41 further comprising:

the optical interference pattern generating means is an etalon.

50. The apparatus of claim 42 further comprising:

the optical interference pattern generating means is an etalon.

51. The apparatus of claim 43 further comprising:

the optical interference pattern generating means is an etalon.

52. The apparatus of claim 44 further comprising:

the optical interference pattern generating means is an etalon.

53. The apparatus of claim 45 further comprising:

the optical interference pattern generating means is an etalon.

54. The apparatus of claim 46 further comprising:

the optical interference pattern generating means is an etalon.

55. The apparatus of claim 47 further comprising:

the optical interference pattern generating means is an etalon.

56. The apparatus of claim 48 further comprising:

the optical interference pattern generating means is an etalon.

57. The apparatus of claim 49 further comprising:

the etalon is an etalon having a slit function of 3pm or less and a finesses of 25 or greater; and

the focal length is 1.5 meters.

58. The apparatus of claim 50 further comprising:

the etalon is an etalon having a slit function of 3pm or less and a finesses of 25 or greater; and

the focal length is 1.5 meters.

59. The apparatus of claim 51 further comprising:

the etalon is an etalon having a slit function of 3pm or less and a finesses of 25 or greater; and

the focal length is 1.5 meters.

60. The apparatus of claim 52 further comprising:

the etalon is an etalon having a slit function of 3pm or less and a finesses of 25 or greater; and

the focal length is 1.5 meters.

61. The apparatus of claim 53 further comprising:

the etalon is an etalon having a slit function of 3pm or less and a finesses of 25 or greater; and

the focal length is 1.5 meters.

62. The apparatus of claim 54 further comprising:

the etalon is an etalon having a slit function of 3pm or less and a finesses of 25 or greater; and

the focal length is 1.5 meters.

63. The apparatus of claim 55 further comprising:

the etalon is an etalon having a slit function of 3pm or less and a finesses of 25 or greater; and

the focal length is 1.5 meters.

64. The apparatus of claim 56 further comprising:

the etalon is an etalon having a slit function of 3pm or less and a finesses of 25 or greater; and

the focal length is 1.5 meters.

65. The apparatus of claim 57 further comprising:

a first diffuser delivering a narrow cone of light to the etalon.

66. The apparatus of claim 58 further comprising:

a first diffuser delivering a narrow cone of light to the etalon.

67. The apparatus of claim 59 further comprising:

a first diffuser delivering a narrow cone of light to the etalon.

68. The apparatus of claim 60 further comprising:

a first diffuser delivering a narrow cone of light to the etalon.

69. The apparatus of claim 61 further comprising:

a first diffuser delivering a narrow cone of light to the etalon.

70. The apparatus of claim 62 further comprising:

a first diffuser delivering a narrow cone of light to the etalon.

71. The apparatus of claim 63 further comprising:

a first diffuser delivering a narrow cone of light to the etalon.

72. The apparatus of claim 64 further comprising:

a first diffuser delivering a narrow cone of light to the etalon.

73. The apparatus of claim 65 further comprising:

an aperture between the first diffuser and the etalon delivering to the etalon a thin strip of the narrow cone of light.

74. The apparatus of claim 66 further comprising:

an aperture between the first diffuser and the etalon delivering to the etalon a thin strip of the narrow cone of light.

75. The apparatus of claim 67 further comprising:

an aperture between the first diffuser and the etalon delivering to the etalon a thin strip of the narrow cone of light.

76. The apparatus of claim 68 further comprising:

an aperture between the first diffuser and the etalon delivering to the etalon a thin strip of the narrow cone of light.

77. The apparatus of claim 69 further comprising:

an aperture between the first diffuser and the etalon delivering to the etalon a thin strip of the narrow cone of light.

78. The apparatus of claim 70 further comprising:

an aperture between the first stage diffuser and the etalon delivering to the etalon a thin strip of the narrow cone of light.

79. The apparatus of claim 71 further comprising:

an aperture between the first diffuser and the etalon delivering to the etalon a thin strip of the narrow cone of light.

80. The apparatus of claim 72 further comprising:

an aperture between the first diffuser and the etalon delivering to the etalon a thin strip of the narrow cone of light.

81. A method of measuring bandwidth of light produced by a high repetition rate gas discharge laser having a laser output beam comprising a pulsed output of greater than or equal to 15 mJ per pulse, sub-nanometer bandwidth tuning range pulses having a femptometer bandwidth precision and tens of femptometers bandwidth accuracy range, for measuring bandwidth on a pulse to pulse basis at pulse repetition rates of 4000Hz and above, comprising:

focusing the light in a lens having a focal length;

creating an interference fringe pattern;

detecting the interference fringe pattern in an optical detector positioned at the focal length from the lens;

calculating bandwidth from the position of interference fringes in the interference fringe pattern incident on the optical detector, defining a D_{ID} and a D_{OD}, the respective distances between a pair of first fringe borders and between a pair of second fringe borders in the interference fringe pattern on an axis of the interference fringe pattern, and according to the formula $\Delta\lambda = \lambda_0 [D_{OD}^2 - D_{ID}^2] / [8f^2 - D_0^2]$, where λ_0 is an assumed constant wavelength and $D_0 = (D_{OD} - D_{ID})/2$, and f is the focal length.

82. The method of claim 81 further comprising:

the optical detector is a photodiode array.

83. The method of claim 81, further comprising:

creating the interference pattern in an optical interferometer having a slit function;

the slit function and the focal length being selected to deliver to the optical detection means the two innermost fringes of the optical interference ring pattern.

84. The method of claim 82, further comprising:

creating the interference pattern in an optical interferometer having a slit function;

the slit function and the focal length being selected to deliver to the optical detector the two innermost fringes of the optical interference ring pattern..

85. The method of claim 81, further comprising:

the optical detector comprising an array of pixels each having a height and width and the array having a total width;

creating the interference fringe pattern in an optical interferometer;

selectively inputting to the optical interferometer a slit portion of a beam of light sufficient for the output of the optical interferometer to illuminate the optical detection means over the height of each respective pixel height.

86. The method of claim 82, further comprising:

the optical detector comprising an array of pixels each having a height and width and the array having a total width;

creating the interference fringe pattern in an optical interferometer;

selectively inputting to the optical interferometer a slit portion of a beam of light sufficient for the output of the optical interferometer to illuminate the optical detection over the height of each respective pixel height.

87. The method of claim 83, further comprising:

the optical detector comprising an array of pixels each having a height and width and the array having a total width;

selectively inputting to the optical interferometer a slit portion of a beam of light sufficient for the output of the optical interferometer to illuminate the optical detection means over the height of each respective pixel height.

88. The method of claim 84, further comprising:

the optical detector comprising an array of pixels each having a height and width and the array having a total width;

selectively inputting to the optical interferometer a slit portion of a beam of light sufficient for the output of the optical interferometer to illuminate the optical detection means over the height of each respective pixel height.

89. The method of claim 81 further comprising:

creating the interference pattern in an etalon having a slit function.

90. The method of claim 82 further comprising:

creating the interference pattern in an etalon having a slit function.

91. The method of claim 83 further comprising:

the optical interferometer is an etalon.

92. The method of claim 84 further comprising:

the optical interferometer is an etalon.

93. The method of claim 85 further comprising:

the optical interferometer is an etalon.

94. The method of claim 86 further comprising:

the optical interferometer is an etalon.

95. The method of claim 87 further comprising:

the optical interferometer is an etalon.

96. The method of claim 88 further comprising:

the optical interferometer is an etalon.

97. The method of claim 89 further comprising:

the etalon is an etalon having a slit function of 3pm or less and a finesses of 25 or greater; and

the focal length is 1.5 meters.

98. The method of claim 90 further comprising:

the etalon is an etalon having a slit function of 3pm or less and a finesses of 25 or greater; and

the focal length is 1.5 meters.

99. The method of claim 91 further comprising:

the etalon is an etalon having a slit function of 3pm or less and a finesses of 25 or greater; and

the focal length is 1.5 meters.

100. The method of claim 92 further comprising:

the etalon is an etalon having a slit function of 3pm or less and a finesses of 25 or greater; and

the focal length is 1.5 meters.

101. The method of claim 93 further comprising:

the etalon is an etalon having a slit function of 3pm or less and a finesses of 25 or greater; and

the focal length is 1.5 meters.

102. The method of claim 94 further comprising:

the etalon is an etalon having a slit function of 3pm or less and a finesses of 25 or greater; and

the focal length is 1.5 meters.

103. The method of claim 95 further comprising:

the etalon is an etalon having a slit function of 3pm or less and a finesses of 25 or greater; and

the focal length is 1.5 meters.

104. The method of claim 96 further comprising:

the etalon is an etalon having a slit function of 3pm or less and a finesses of 25 or greater; and

the focal length is 1.5 meters.

105. The method of claim 97 further comprising:

delivering a narrow cone of diffused light to the etalon.

106. The method of claim 98 further comprising:

delivering a narrow cone of diffused light to the etalon.

107. The method of claim 99 further comprising:

delivering a narrow cone of diffused light to the etalon.

108. The method of claim 100 further comprising:

delivering a narrow cone of diffused light to the etalon.

109. The method of claim 101 further comprising:

delivering a narrow cone of diffused light to the etalon.

110. The method of claim 102 further comprising:

delivering a narrow cone of diffused light to the etalon.

111. The method of claim 103 further comprising:

delivering a narrow cone of diffused light to the etalon.

112. The method of claim 104 further comprising:

delivering a narrow cone of diffused light to the etalon.

113. The apparatus of claim 105 further comprising:
passing the narrow cone of light through a slit aperture.

114. The apparatus of claim 106 further comprising:
passing the narrow cone of light through a slit aperture.

115. The apparatus of claim 107 further comprising:
passing the narrow cone of light through a slit aperture.

116. The apparatus of claim 108 further comprising:
passing the narrow cone of light through a slit aperture.

117. The apparatus of claim 109 further comprising:
passing the narrow cone of light through a slit aperture.

118. The apparatus of claim 110 further comprising:
passing the narrow cone of light through a slit aperture.

119. The apparatus of claim 111 further comprising:
passing the narrow cone of light through a slit aperture.

120. The apparatus of claim 112 further comprising:
passing the narrow cone of light through a slit aperture.

121. The apparatus of claim 33 further comprising:
a beam narrower in the path of the beam before the optical interferometer;
a second diffuser between the beam narrower and the optical interferometer;
the beam narrower narrowing the beam more in a first axis than in a second axis to conform the beam cross section to the shape of the second diffuser.

122. The apparatus of claim 34 further comprising:

a beam narrower in the path of the beam before the optical interferometer;

a second diffuser between the beam narrower and the optical interferometer;

the beam narrower narrowing the beam more in a first axis than in a second axis to conform the beam cross section to the shape of the second diffuser.

123. The apparatus of claim 35 further comprising:

a beam narrower in the path of the beam before the optical interferometer;

a second diffuser between the beam narrower and the optical interferometer;

the beam narrower narrowing the beam more in a first axis than in a second axis to conform the beam cross section to the shape of the second diffuser.

124. The apparatus of claim 36 further comprising:

a beam narrower in the path of the beam before the optical interferometer;

a second diffuser between the beam narrower and the optical interferometer;

the beam narrower narrowing the beam more in a first axis than in a second axis to conform the beam cross section to the shape of the second diffuser.

125. The apparatus of claim 37 further comprising:

a beam narrower in the path of the beam before the optical interferometer;

a second diffuser between the beam narrower and the optical interferometer;

the beam narrower narrowing the beam more in a first axis than in a second axis to conform the beam cross section to the shape of the second diffuser.

128. The apparatus of claim 38 further comprising:

a beam narrower in the path of the beam before the optical interferometer;

a second diffuser between the beam narrower and the optical interferometer;

the beam narrower narrowing the beam more in a first axis than in a second axis to conform the beam cross section to the shape of the second diffuser.

129. The apparatus of claim 39 further comprising:

a beam narrower in the path of the beam before the optical interferometer;

a second diffuser between the beam narrower and the optical interferometer;

the beam narrower narrowing the beam more in a first axis than in a second axis to conform the beam cross section to the shape of the second diffuser.

130. The apparatus of claim 40 further comprising:

a beam narrower in the path of the beam before the optical interferometer;

a second diffuser between the beam narrower and the optical interferometer;

the beam narrower narrowing the beam more in a first axis than in a second axis to conform the beam cross section to the shape of the second diffuser.

131. The apparatus of claim 73 further comprising:

a beam narrowing means in the path of the beam before the optical interferometer;

a second diffuser between the beam narrowing means and the optical interferometer;

the beam narrowing means narrowing the beam more in a first axis than in a second axis to conform the beam cross section to the shape of the second diffuser.

132. The apparatus of claim 74 further comprising:

a beam narrowing means in the path of the beam before the optical interferometer;

a second diffuser between the beam narrowing means and the optical interferometer;

the beam narrowing means narrowing the beam more in a first axis than in a second axis to conform the beam cross section to the shape of the second diffuser.

133. The apparatus of claim 75 further comprising:

a beam narrowing means in the path of the beam before the optical interferometer;

a second diffuser between the beam narrowing means and the optical interferometer;

the beam narrowing means narrowing the beam more in a first axis than in a second axis to conform the beam cross section to the shape of the second diffuser.

134. The apparatus of claim 76 further comprising:

a beam narrowing means in the path of the beam before the optical interferometer;

a second diffuser between the beam narrowing means and the optical interferometer;

the beam narrowing means narrowing the beam more in a first axis than in a second axis to conform the beam cross section to the shape of the second diffuser.

135. The apparatus of claim 77 further comprising:

a beam narrowing means in the path of the beam before the optical interferometer;

a second diffuser between the beam narrowing means and the optical interferometer;

the beam narrowing means narrowing the beam more in a first axis than in a second axis to conform the beam cross section to the shape of the second diffuser.

136. The apparatus of claim 78 further comprising:

a beam narrowing means in the path of the beam before the optical interferometer;

a second diffuser between the beam narrowing means and the optical interferometer;

the beam narrowing means narrowing the beam more in a first axis than in a second axis to conform the beam cross section to the shape of the second diffuser.

137. The apparatus of claim 79 further comprising:

a beam narrowing means in the path of the beam before the optical interferometer;

a second diffuser between the beam narrowing means and the optical interferometer;

the beam narrowing means narrowing the beam more in a first axis than in a second axis to conform the beam cross section to the shape of the second diffuser.

138. The apparatus of claim 80 further comprising:

a beam narrowing means in the path of the beam before the optical interferometer;

a second diffuser between the beam narrowing means and the optical interferometer;

the beam narrowing means narrowing the beam more in a first axis than in a second axis to conform the beam cross section to the shape of the second diffuser.

139. The method of claim 113 further comprising:

narrowing the beam before creating the interference pattern;

diffusing the narrowed beam in a second diffuser;

narrowing the beam more in a first axis than in a second axis to conform the beam cross section to the shape of the second diffuser.

140. The method of claim 114 further comprising:

narrowing the beam before creating the interference pattern;

diffusing the narrowed beam in a second diffuser;

narrowing the beam more in a first axis than in a second axis to conform the beam cross section to the shape of the second diffuser.

141. The method of claim 115 further comprising:

narrowing the beam before creating the interference pattern;

diffusing the narrowed beam in a second diffuser;

narrowing the beam more in a first axis than in a second axis to conform the beam cross section to the shape of the diffuser.

142. The method of claim 116 further comprising:

narrowing the beam before creating the interference pattern;

diffusing the narrowed beam in a diffuser;

narrowing the beam more in a first axis than in a second axis to conform the beam cross section to the shape of the second diffuser.

143. The method of claim 117 further comprising:

narrowing the beam before creating the interference pattern;

diffusing the narrowed beam in a second diffuser;

narrowing the beam more in a first axis than in a second axis to conform the beam cross section to the shape of the second diffuser.

144. The method of claim 118 further comprising:

narrowing the beam before creating the interference pattern;

diffusing the narrowed beam in a second diffuser;

narrowing the beam more in a first axis than in a second axis to conform the beam cross section to the shape of the second diffuser.

145. The method of claim 119 further comprising:

narrowing the beam before creating the interference pattern;

diffusing the narrowed beam in a second diffuser;

narrowing the beam more in a first axis than in a second axis to conform the beam cross section to the shape of the second diffuser.

146. The method of claim 120 further comprising:

narrowing the beam before creating the interference pattern;

diffusing the narrowed beam in a second diffuser;

narrowing the beam more in a first axis than in a second axis to conform the beam cross section to the shape of the second diffuser.

147. The apparatus of claim 25 further comprising:

the first diffuser comprises an etched ground glass diffuser delivering a cone angle of less than fifteen degrees.

148. The apparatus of claim 26 further comprising:

the first diffuser comprises an etched ground glass diffuser delivering a cone angle of less than fifteen degrees.

149. The apparatus of claim 27 further comprising:

the first diffuser comprises an etched ground glass diffuser delivering a cone angle of less than fifteen degrees.

150. The apparatus of claim 28 further comprising:

the first diffuser comprises an etched ground glass diffuser delivering a cone angle of less than fifteen degrees.

151. The apparatus of claim 29 further comprising:

the first diffuser comprises an etched ground glass diffuser delivering a cone angle of less than fifteen degrees.

152. The apparatus of claim 30 further comprising:

the first diffuser comprises an etched ground glass diffuser delivering a cone angle of less than fifteen degrees.

153. The apparatus of claim 31 further comprising:

the first diffuser comprises an etched ground glass diffuser delivering a cone angle of less than fifteen degrees.

154. The apparatus of claim 32 further comprising:

the first diffuser comprises an etched ground glass diffuser delivering a cone angle of less than fifteen degrees.